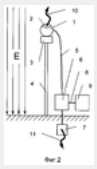
# Device for obtaining energy from the electric field of the atmosphere


## Abstract

The invention relates to electrical engineering and is intended for uninterrupted power supply of autonomous electrical equipment, for example, automatic weather stations or space probes. The technical result of the invention is the uninterrupted generation of energy from the electric field of the atmosphere in the required quantity. The device is easy, lack of moving parts, the simplicity of structural elements and the convenience of their transportation. The device contains electrodes, a supporting structure and ionizers of atmospheric gas. The electrodes are spaced along the lines of force of the electric field. Surrounded by the atmosphere, the electrodes are located on a supporting structure. The outer surface of these electrodes is structurally combined with ionizers of atmospheric gas. The lower electrode is a grounding electrode. Between the electrodes, Distances along the lines of force of the atmospheric electric field include the load. In the absence of contact of the device with the planet, the outer surface of all atmosphere-surrounded electrodes is structurally combined with ionizers of atmospheric gas. Current-carrying parts of the device, which are under voltage, are electrically isolated from the supporting structure. 2 yl.


## Images (1)

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## Claims (1)

1. A device for obtaining energy from the electric field of the atmosphere, including electrodes spaced along field lines, the lower of which is an earth electrode, a supporting structure with atmosphere-surrounded electrodes, ionizers of atmospheric gas structurally aligned with the outer surface of these electrodes, characterized in that between spaced apart field lines with electrodes, the load is switched on, in the absence of contact of the device with the planet, the outer surface of all atmosphere-surrounded electrodes about aligned with the ionization of atmospheric gas, the conductive portion of the device under voltage, electrically insulated from the supporting structure.

## Description

The invention relates to electrical engineering and is intended for uninterrupted power supply of autonomous electrical equipment, for example automatic weather station or space probes on the Earth and other planets having an atmospheric electric field.

Known difficulties associated with the uninterrupted power supply of autonomous electrical equipment. Internal sources of energy (batteries, batteries, fuel cells) require periodic replacement, refueling or recharging, that is, manual, manual maintenance. External sources of energy (running water, wind, sunlight) require massive large structures, converters with moving parts and are not always available.

To solve the problem, we need a low-power, but reliable uninterrupted source of energy at any time and in any place. Taking into account the operating conditions of the autonomous electrical equipment, it must be lightweight, structurally simple and convenient for transportation to any distances.

There are known devices for the indirect generation of energy from the atmosphere by means of water wheels, turbines and other hydropower plants, as well as for direct energy production from the atmosphere by means of windmills, turbines and other windmills. In these devices, the energy of the atmosphere is converted into heat, work or electricity.

The continuity of the supply of energy generated with their help can not be ensured. It depends on the state of the atmosphere, climatic conditions and season. (Chaly G. Energy yesterday, today, tomorrow - Chisinau: Kartia Moldovenna, 1977. - 202 pp., Ill., Pp. 44-64,).

For the prototype a lightning rod is adopted, which is designed to neutralize the energy of the atmospheric electric field. The lightning rod contains a vertically oriented bearing structure that rises above the terrain, and electrodes spaced along field lines, connected by a current collector. At the top of the structure, there is an electrode surrounded by an atmosphere - a lightning receiver in the form of a massive metal rod. It can be combined with an ionizer of atmospheric gas. The lower electrode is a grounding electrode and provides electrical contact of the device with the planet's surface (VVBazutkin et al., High Voltage Engineering .- Moscow: Energoatomizdat, textbook for high schools, 1986. - 464 p., Ill., Pp. 219-220 ). The construction of the lightning rod does not include the payload.

The features of the prototype, which coincide with the essential features of the claimed invention, are as follows. The lightning conductor contains electrodes, a supporting structure and ionizers of atmospheric gas. The electrodes are spaced along the lines of force of the electric field. Surrounded by the atmosphere, the

electrodes are located on a supporting structure. The outer surface of these electrodes is structurally combined with ionizers of atmospheric gas. The lower electrode is a grounding electrode.

The reasons for preventing the required technical result from the prototype are as follows. Lightning conductor ensures the flow through the atmosphere of electric current only in the form of a periodic spark discharge. The transit time of this current is unpredictable, and the magnitude is random and can not be adjusted. The lightning rod does not contain a payload. It is designed to work in an abnormally strong electric field and for the most part of time is uselessly idle. Lightning conductor does not work in places where there are no thunderclouds. The lightning rod does not work in the absence of contact with the planet. The live parts of the lightning rod do not have electrical insulation from the supporting structure.

The technical result is the uninterrupted reception of energy from the electric field of the atmosphere in the required quantity and the creation for this purpose of the claimed device.

The device is advantageous for its lightness, lack of moving parts, simplicity of necessary structural elements and convenience of their transportation. It is more reliable than all devices of autonomous power supply, including wind generators and solar panels, since the electric field of the atmosphere depends little on the time of the year, exists around the clock and is accessible anywhere in the world.

The technical result is achieved as follows. Between the electrodes spaced along the lines of force of the atmospheric electric field, a load is applied. In the absence of contact of the device with the planet, the outer surface of all atmosphere-surrounded electrodes is structurally combined with ionizers of atmospheric gas. Current-carrying parts of the device, which are under voltage, are electrically isolated from the supporting structure.

The essential features of the claimed invention are as follows. An apparatus for recovering energy from the atmospheric electric field comprises electrodes spaced along the electric field lines, the lower electrode is an earth electrode. The electrodes surrounded by the atmosphere are placed on a supporting structure. Ionizers of atmospheric gas are structurally combined with the outer surface of the atmosphere surrounded by an electrode.

Unlike the prototype between spaced along the electric field lines included electrodes load. In the absence of the device in contact with the outer surface of the planet electrodes structurally combined with the atmospheric gas ionizers. The current-carrying live parts of the device are electrically isolated from the supporting structure.

The farther apart the electrodes are separated, the higher the electric field strength near their surface and the greater the spreading rate of free charge carriers in the surrounding gas. Surrounded by the atmosphere, the electrodes are advantageously placed in the vertically spaced points of the supporting structure. Spreading of charge carriers in the atmosphere is facilitated by free movement of gas at the electrodes and the absence of other voltage concentrators around the device.

If there is a contact between the device and the planet, the lower electrode is an earth electrode. This provides a low electrical resistance to the passage of atmospheric electric current through the ground. If there is no contact of the device with the planet, the atmospheric electric current created by it can pass only through the gas discharge channel. In this case, all electrodes surrounded by atmosphere (both upper and lower) are structurally combined with ionizers of atmospheric gas. Thus, the uninterrupted conversion of the energy of the atmospheric electric field into the energy of the electric current flowing through the load is ensured. Further useful conversion of this energy into heat, work or electricity is accomplished by choosing the type of load (heater, electric motor or other electrical equipment).

The effect of the essential features of the claimed invention on the resulting technical effect is as follows. The supporting structure ensures the correct orientation of the device in the atmospheric electric field, which coincides with the direction of its lines of force. It keeps the electrodes spaced along the field lines at the required distance, provides mechanical strength of the device and integrates its individual parts into a single whole. Electrodes should be moved apart from each other for the maximum technically possible distance. Proportional to the distance increases the strength of the electric field on their outer surface, which increases the mobility of charge carriers in the surrounding atmosphere and facilitates the flow of electric current through it.

If there is a contact between the device and the planet, the lower electrode is an earth electrode. This is the simplest, cheapest and reliable way to provide low resistance to the current flowing through it into the ground. Surrounded by the atmosphere, the electrodes are mounted on a supporting structure. This ensures the stability of their spatial position in an external electric field. Ionizers of atmospheric gas are structurally combined with the outer surface of the atmosphere surrounded by an electrode. This ensures a constant presence of a sufficient number of free charge carriers in the space adjacent to the electrodes and the free movement of these charges along the lines of force of the electric field. Thus, an electrical contact is provided with a low resistance between the solid electrodes and the atmospheric gas. The strength of a current passing through such a contact within a wide range does not depend on the strength of the external electric field and is determined only by the capacity of the ionizers. This guarantees the uninterrupted availability of energy, regardless of external factors, minimizes the power consumption for maintaining the channel of a non-self-sustaining electrical discharge through a neutral atmosphere and prevents the occurrence of inrush currents through the device in conditions of thunderstorm activity.

If there is no contact of the device with the planet, the ionizers of the atmospheric gas are structurally combined with the outer surface of all the electrodes surrounded by the atmosphere, both upper and lower. This is the only available way to ensure the flow of electric current through the atmosphere on both sides of the device deployed along field lines of force.

The load is included between the electrodes spaced along the lines of force of the electric field. This ensures its serial connection (together with the electrodes) to the circuit of the current passing through the atmosphere of a non-self-sustaining electric discharge. The product of the voltage drop across the load and the amount of current passing through it determines the useful power received by the device from the atmospheric electric field. The coefficient of efficiency of the device is determined by the balance between the load resistance and the transient resistance of the electrodes with the surrounding space (ionizer capacity). The lower the transient resistance of the electrodes, the greater the proportion of energy released in the load.

The insulation of the current-carrying parts of the device from the supporting structure ensures an optimal arrangement of the electric field lines in the surrounding space and helps prevent the flow of electric current through the conductive parts of the device that are not related to its electrical circuit.

The uninterrupted supply of energy is provided by the fact that the electric field of the atmosphere does not depend on the time of the year, exists around the clock in all weathers, is accessible anywhere in the troposphere. This energy resource of the atmosphere is constantly fueled by the full power of the planetary mechanism for separating electric charges.

Reliability of energy supply is ensured by the simplicity of the device, the lack of moving parts in its most important elements. Obtaining energy from the electric field of the atmosphere does not require large structures (dams, towers of great height) and complex technological methods. The maintenance of such a device is much simpler than in analogues.

The simplicity of the design of the elements of the device for obtaining energy from the electric field of the atmosphere follows from the fact that it contains only standard electrotechnical units without movable parts that do not require adjustment, adjustment and regular maintenance. Parts of the device and parts of the supporting structure do not require careful manufacturing.

The ease of transporting the device is achieved by the fact that it is manufactured with a minimum margin of safety, since it does not experience dynamic loads and, therefore, it does not require massive, large-sized units and parts. The device is made foldable or collapsible.

1 shows a general view of an apparatus for generating energy from the electric field of the atmosphere in the absence of contact with the planet.

The device comprises a vertically oriented support structure, for example a balloon, 1, electrodes 2, 3, air ionizers 4 and 5, insulators 6 and 7, cables 8 and 9, voltage converter 10 and a load, for example a radiosonde 11. In the surrounding balloon space, lines of the atmospheric electric field E. Electrodes, structurally combined with air ionizers, are attached to insulators. The balloon keeps the electrodes at a sufficient distance from each other, and the cables connect them to the voltage converter. The voltage converter is connected to the payload electrically and is connected by a common housing.

The device works as follows. After switching on the device, the ionizers 4, 5 saturate the air surrounding the electrodes 2, 3 with free charge carriers. They start drifting through neutral air, moving along the lines of force of the atmospheric electric field E, additionally amplified by the spaced position of the electrodes on the balloon 1. The leakage of charge carriers from the electrodes is compensated by the constant work of the ionizers. A constant electric current flows through the channels of the non-self-sustained gas discharge 12 and 13 from the electrodes through the atmosphere. A difference of potentials appears between the spaced electrodes. They keep it due to insulators 6 and 7. After the appearance of the working difference of potentials (≈5 kV) on the electrodes, the voltage converter 10 switches on. Atmospheric electric current is closed through it via cables 8 and 9.

Determine the electrical power required for autonomous uninterruptible power supply of the payload. For example, to operate the equipment of a modern radiosonde, suspended to an aerostat, a constant electric power of 10 W is sufficient. Determine the limiting electrical power necessary to supply auxiliary devices and air ionizers. For example, in an amount not exceeding 150% of the useful value, that is, 15 watts. Taking into account operating conditions of current collectors, the limiting potential difference between open live parts of the installation is determined. For example, no more than 10 kV is recommended, but actually 5 kV is chosen. The maximum current in the discharge channel is calculated. In this case, no more than (10 W + 15 W) / 5 kV = 5 mA. This value sets the productivity of ionizers, structurally combined with the electrodes. The density of the vertical conduction current and the field strength in the troposphere at the calculated flight altitude are determined. For example, the conduction current is not more than 1.5 μA / $m^2$, the electric field strength is 2.2-3.5 V / m. Calculate the distance between the electrodes, their shape and design, ensuring efficient spreading of the charge carriers created by ionizers in the atmosphere. For example, the distance is 50 m, the shape of the receiving electrodes is a ball, the area of each is not less than 0.5 $m^2$. They fix the electrodes with insulators on the balloon and the suspension system, lay cables, mount a power converter in the container with the equipment.

In Fig. 2, a general view of the device for obtaining energy from the electric field of the atmosphere when the device is in contact with the planet is presented.

The device comprises an electrode 1, an air ionizer 2, an insulator 3, a supporting structure 4, a cable 5, a voltage converter 6, a ground connection 7, a connecting cable 8 and a payload (weather station) 9. In the surrounding space, electric field E. The electrode, structurally combined with the ionizer of air, is attached to the insulator. The stand keeps the electrode at a sufficient height, and the cable connects it to the voltage converter. The voltage converter is electrically connected to the ground through the ground and with the payload through the connecting cable.

The device works as follows:

After switching on the device, the ionizer 2 saturates the air surrounding the electrode 1 with free charge carriers. They begin to drift through neutral air, moving along the lines of the atmospheric electric field E, additionally amplified by the elevated position of the electrode on the column 4. The leakage of the charge carriers from the receiving electrode is compensated by the constant work of the ionizer. A constant electric current flows through the channel of the non-self-sustained gas discharge 10 from the electrode through the atmosphere. The electrode acquires an electrical potential with respect to the ground surface and retains it due to the insulator 3. After the working potential (≈25 kV) appears on the electrode, a voltage converter 6 switches on. The atmospheric electric current closes through it via cable 5 to ground 7.

Determine the electrical power required for autonomous uninterruptible power supply of the payload. For example, for the operation of a modern automatic meteorological station, a constant electric power of 100 W at a nominal voltage of 27 V is sufficient. The limiting electrical power necessary for supplying auxiliary devices and ionizers of air is determined. For example, in an amount not more than 50% of the useful, that is 50 watts. From the climatic conditions and design features of the current collector determine the limiting potential difference between the open live parts of the installation. For example, no more than 30 kV is recommended, but actually 25 kV are chosen. The maximum current in the discharge channel is calculated. In this case, no more than (100 W + 50 W) / 25 kV = 6 mA. This value specifies the productivity of the ionizer, which is structurally combined with the electrode. The electrical activity of the atmosphere (the density of the vertical conduction current and the field strength) in the given area is measured or found from tables. For example, the conduction current is not more than 0.1 μA / $m^2$, the electric field strength is 110-250 V / m. Calculate the height of the rise of the electrode over the terrain, its shape and working surface, sufficient for efficient spreading of charge carriers created by the ionizer in the near-earth atmosphere. For example, the height is not less than 10 m, the shape is a ball, the area is not less than 1 $m^2$. The calculations take into account the wind speed, the presence of other voltage concentrators, the geological structure of the ground and other significant factors. Establish the required height of the rack with an electrode on the insulator, arrange grounding, mount auxiliary electrical equipment and power converter.

Thus, uninterrupted energy supply of autonomous electrical equipment is ensured due to the free force of the atmospheric electric field. The device is advantageously distinguished by the lack of moving parts, the simplicity of the necessary structural elements and the ease of their transportation. It is more reliable than all the devices of autonomous power supply, including wind generators and solar panels, since the electric field of the atmosphere depends little on the time of the year, exists around the clock and is accessible anywhere in the world.

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## Priority And Related Applications

### Priority Applications (1)

| Application | Priority date | Filing date | Title |
|---|---|---|---|
| RU2003106714A | 2003-03-11 | 2003-03-11 | Device for obtaining energy from the electric field of the atmosphere |

### Applications Claiming Priority (1)

| Application | Filing date | Title |
|---|---|---|
| RU2003106714A | 2003-03-11 | Device for obtaining energy from the electric field of the atmosphere |